
2nd Annual
BiTS
CHINA 中国
September 13, 2016
Session 1
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Session 1

Yuanjun Shi

Session Chair

BiTS China

High Frequency & Burn-In

"Implementation Challenges of and ATE Test Cell for At-Speed Production Test of 32 Gbps Applications "

Jose Moreira - Advantest

"Addressing Challenges in High Temperature Burn-In"

Paolo Rodriguez - Analog Devices Philippines

"Derating Transient Voltage Suppressor Diodes for Burn-In Applications"

Gil Conanan - Analog Devices Philippines

"An Ignorable Testing Technology for High Speed/Frequency Device Testing"

Pang Cheng Chiu - Jthink Technology

BiTS 2016 China Burn-in & Test Strategies Workshop

Session 1
施元军
Session Chair

BiTS China

High Frequency & Burn-In

"32 Gbps速度应用在自动测试单元量产实施中的挑战 "

Jose Moreira – Advantest

"高温老化测试挑战的讨论"

Paolo Rodriguez - Analog Devices Philippines

"老化测试中瞬态电压抑制器的降额设计"

Gil Conanan - Analog Devices Philippines

"一个不容忽视的高速芯片测试方法"

Pang Cheng Chiu - Jthink Technology

An Ignorable Testing Technology for High Speed/Frequency Device Testing

Pang Cheng Chiu[1], Lung Shu Huang[1], Sung Mao Wu[2]
Kuan-I Cheng[2], Chih-Cheng Chuang[2]
[1] Jthink Technology Ltd.
[2] National University of Kaohsiung, Taiwan

BiTS China Workshop
Suzhou
September 13, 2016

Agenda

- Motivation
- Designed Kits for SOLT Calibration Method
- Verification
  - Calibration Kit
  - Product Samples
- Conclusion

Motivation

- **Why** we do the SOLT calibration method on socket for QFN package?

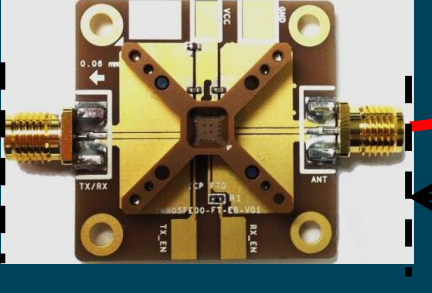
VNA

Traditional Calibration Kit by Keysight

Can't bypass the test board and socket effect

RF Cable

RF Cable

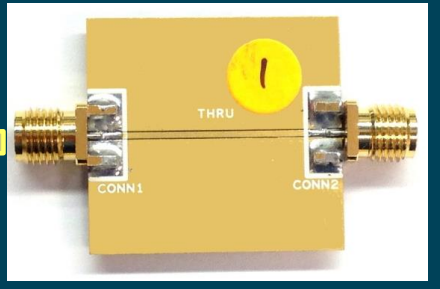


Calibration Plane

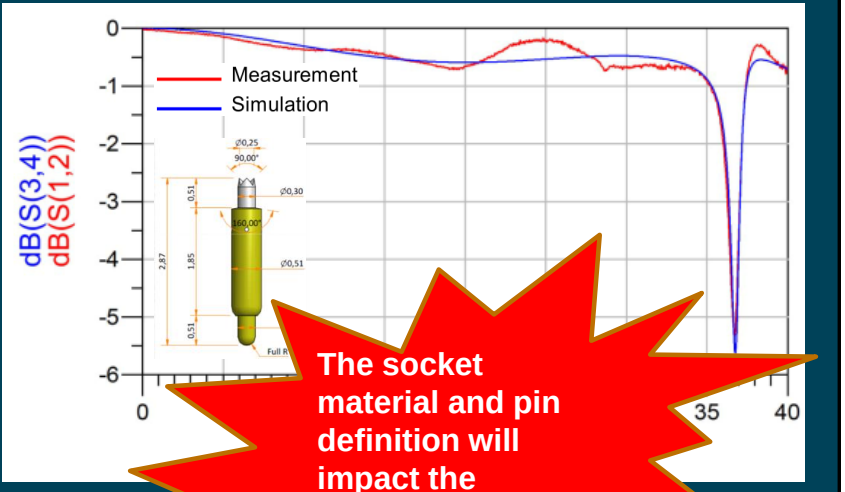
Calibration Plane

Motivation

Currently Method : Design twice RF trace length.



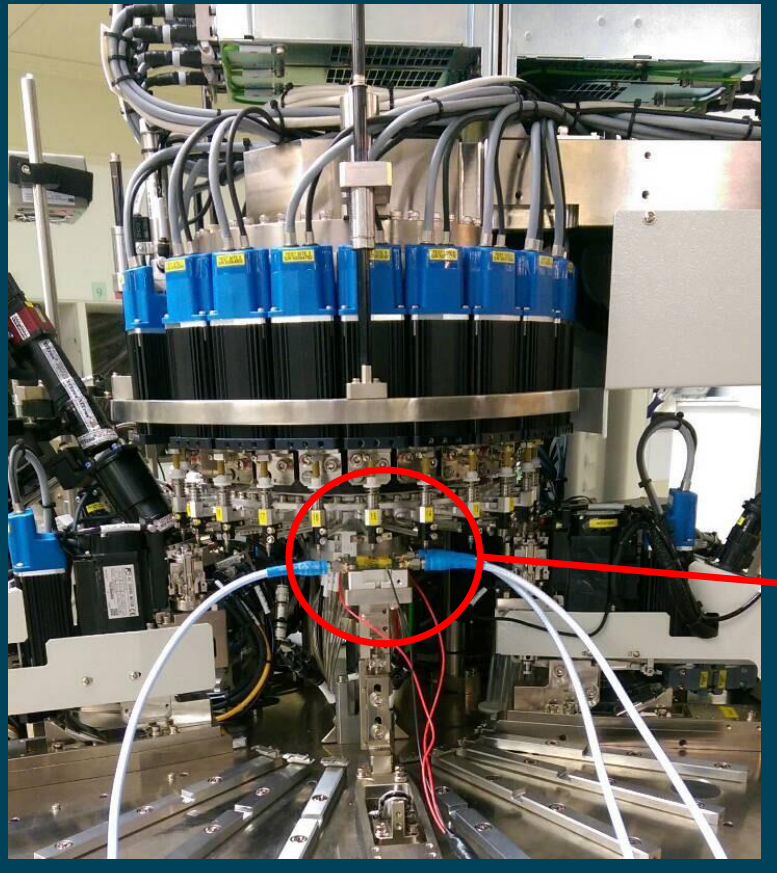
S-parameter provide from pogo pin vendor



The insertion loss is similar to test board, but it is excluding pogo pin effect.

The socket material and pin definition will impact the insertion loss.

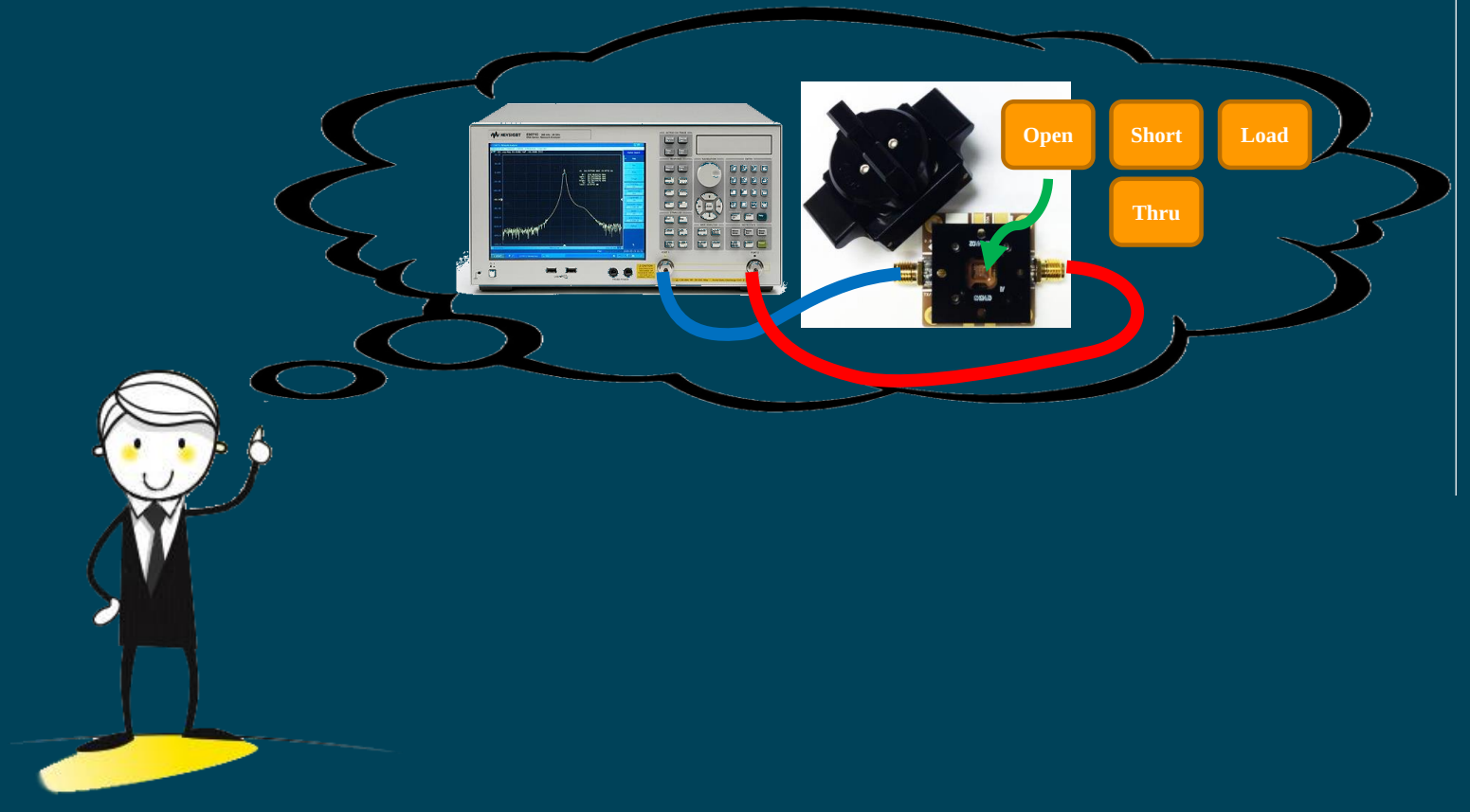
Motivation



Traditional Calibration Kit by Keysight

- It is difficult for calibration because the space is limited on tester.
- Using tradition calibration kit need to spend about 20 min doing calibration.

Motivation



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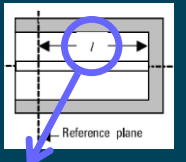
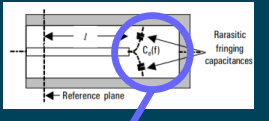
What's SOLT Calibration Method?

S O L T

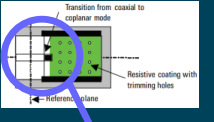
Short



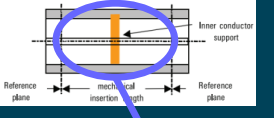
Open



Load



Through



$L = L_0 + L_1 \cdot f^1 + L_2 \cdot f^2 + L_3 \cdot f^3$

$C = C_0 + C_1 \cdot f^1 + C_2 \cdot f^2 + C_3 \cdot f^3$

Z_0

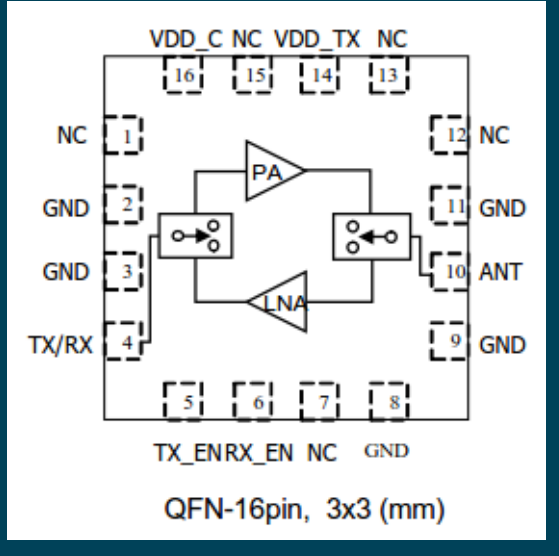
Phase Delay & Offset Loss

Well-known

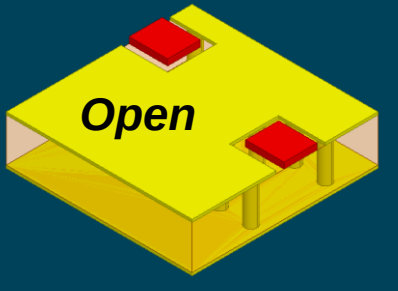
Calibration of Standard Definition for VNA	
Short	$L_0,\ L_1,\ L_2,\ L_3$
Open	$C_0,\ C_1,\ C_2,\ C_3$
Load	Z_0
Through	Phase Delay & offset loss

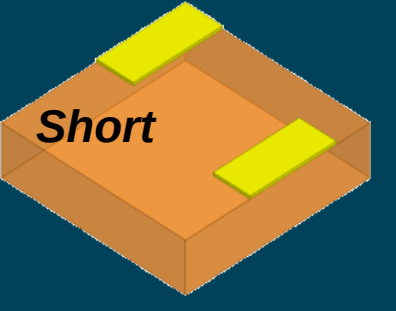
What's SOLT Calibration Method?

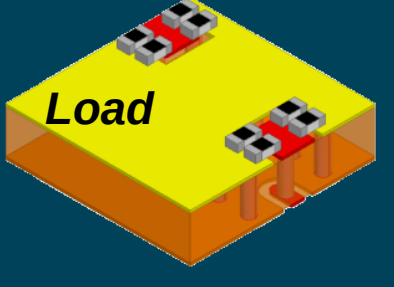
Jthink Solution For Socket Calibration

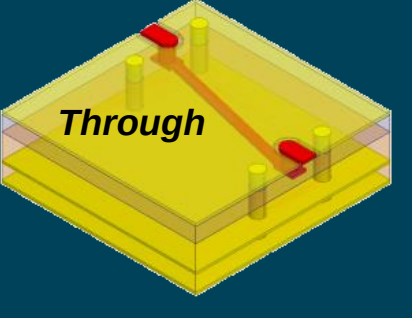


Pin Definition









Measurement Equipment
(For Socket Cal Kit Extraction)

Measurement Equipment

Probe Station

VNA Keysight 5071C

Band Width: 300k ~ 20GHz

Measurement Probe and Calibration Kit

Cascade RF Microwave

Probe

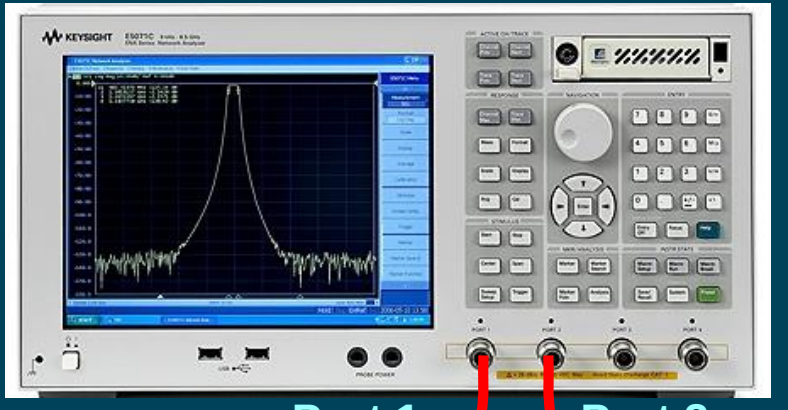
Type: GSG 500 um

Impendence Standard

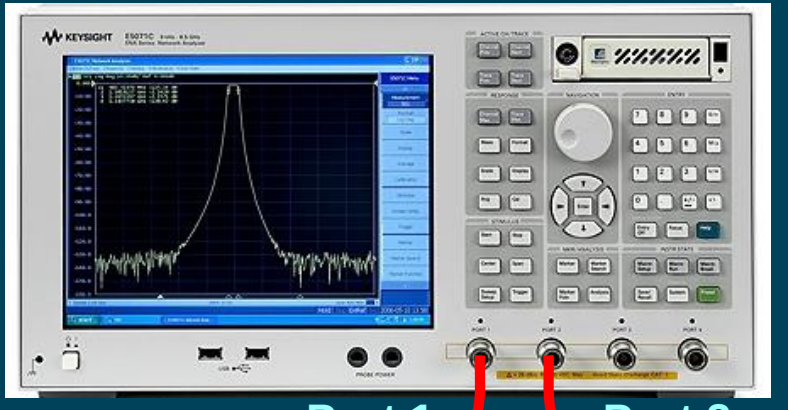
Substrate

SN: 109-531

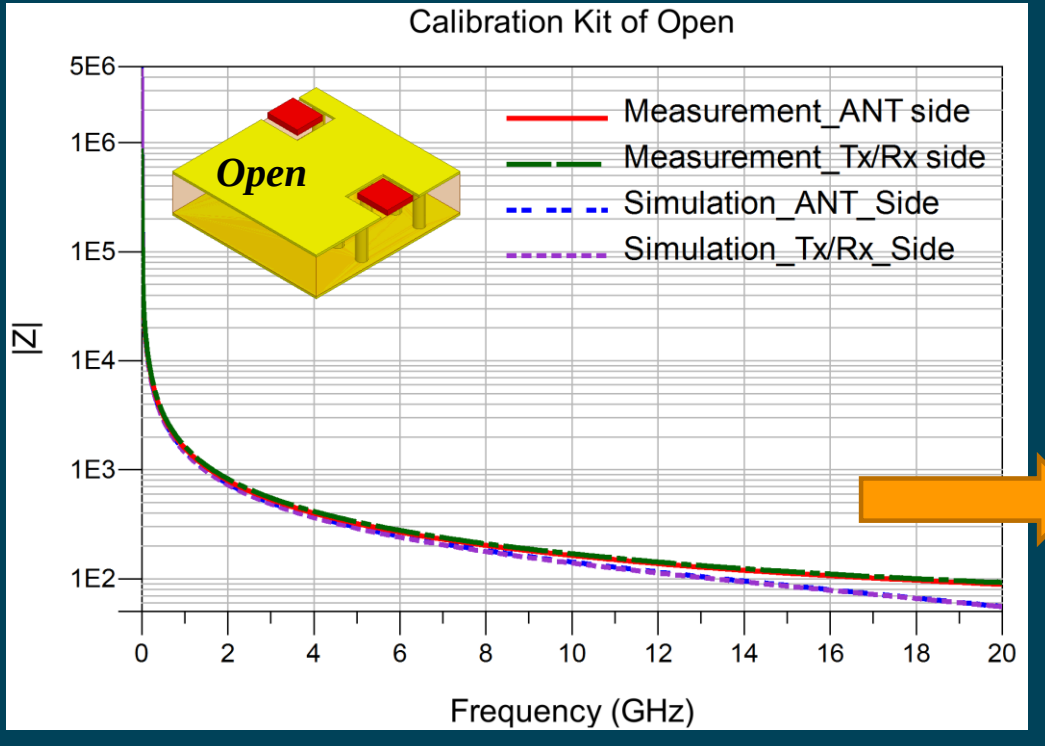
Socket Cal Kit Extraction



Socket Cal Kit Extraction



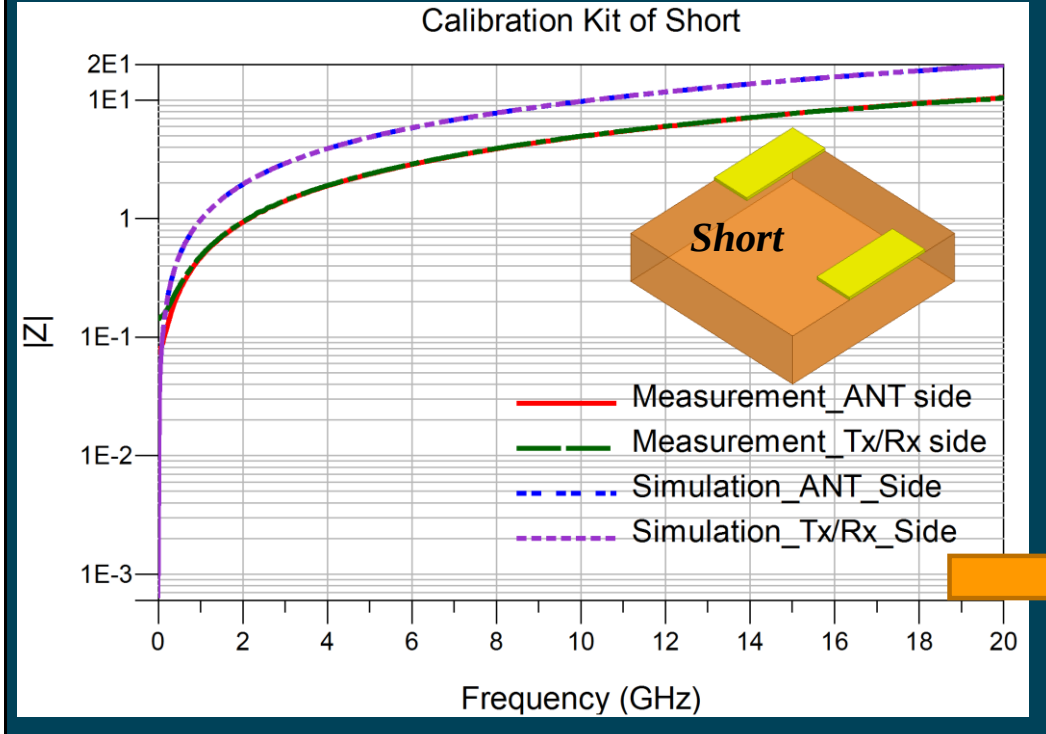
Socket Cal Kit Extraction



$C_{0_{ANT}} = 96.5\ fF$

$C_{0_{Tx/Rx}} = 93.1\ fF$

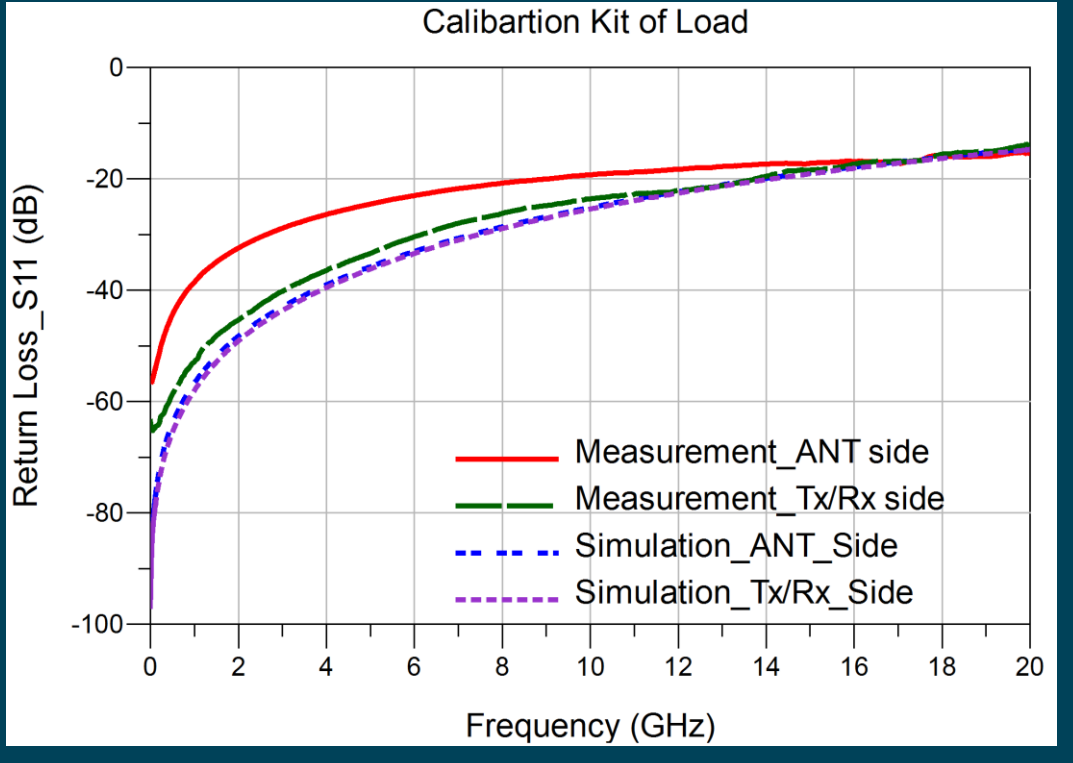
Socket Cal Kit Extraction



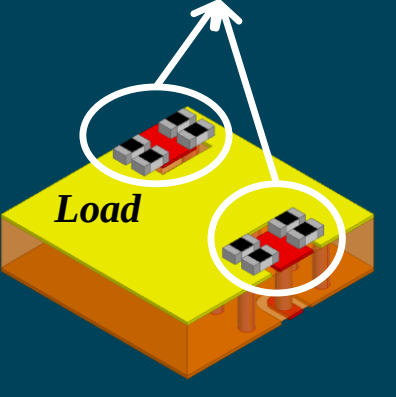
$$L_{0\,ANT} = 79.3\ pH$$

$$L_{0\,Tx/Rx} = 79.3\ pH$$

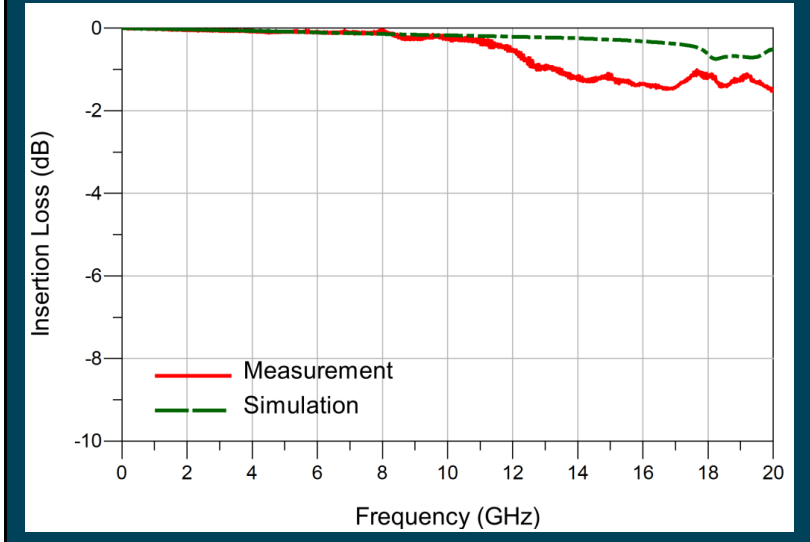
Socket Cal Kit Extraction

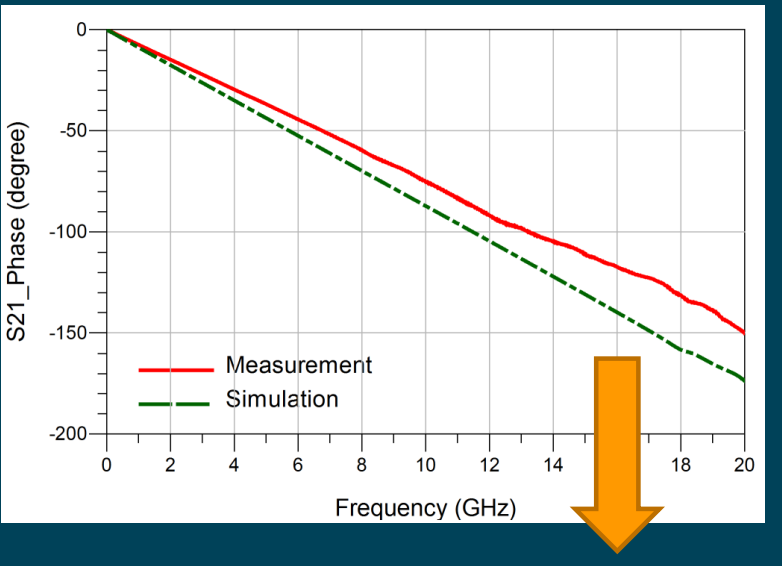


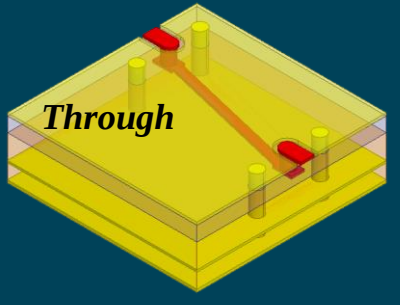
- 4 resistors are parallel at each side.
- The resistor is 200 ohm.



Socket Cal Kit Extraction







$Phase\ Delay = 20.833\ ps$

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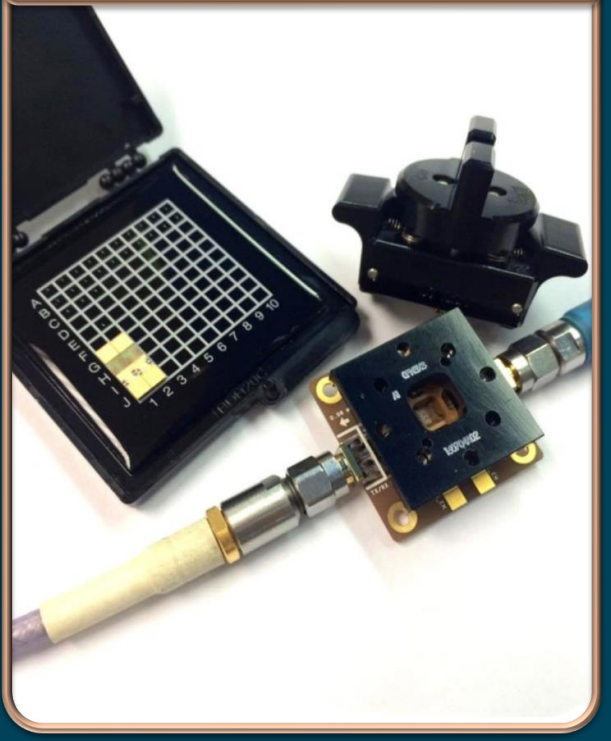
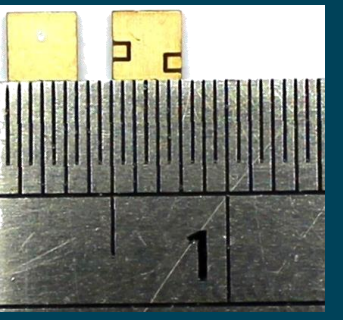
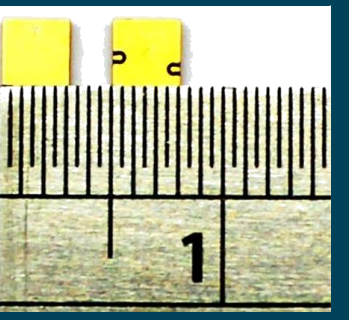
Calibration Environment for Socket Application

Measurement Environment

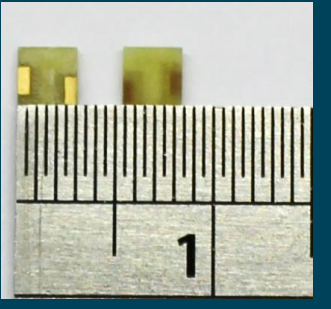




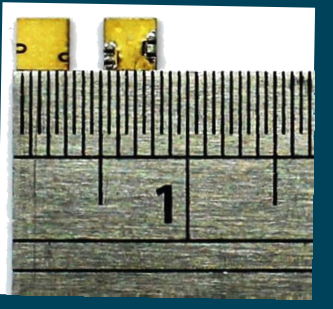
Open



Through

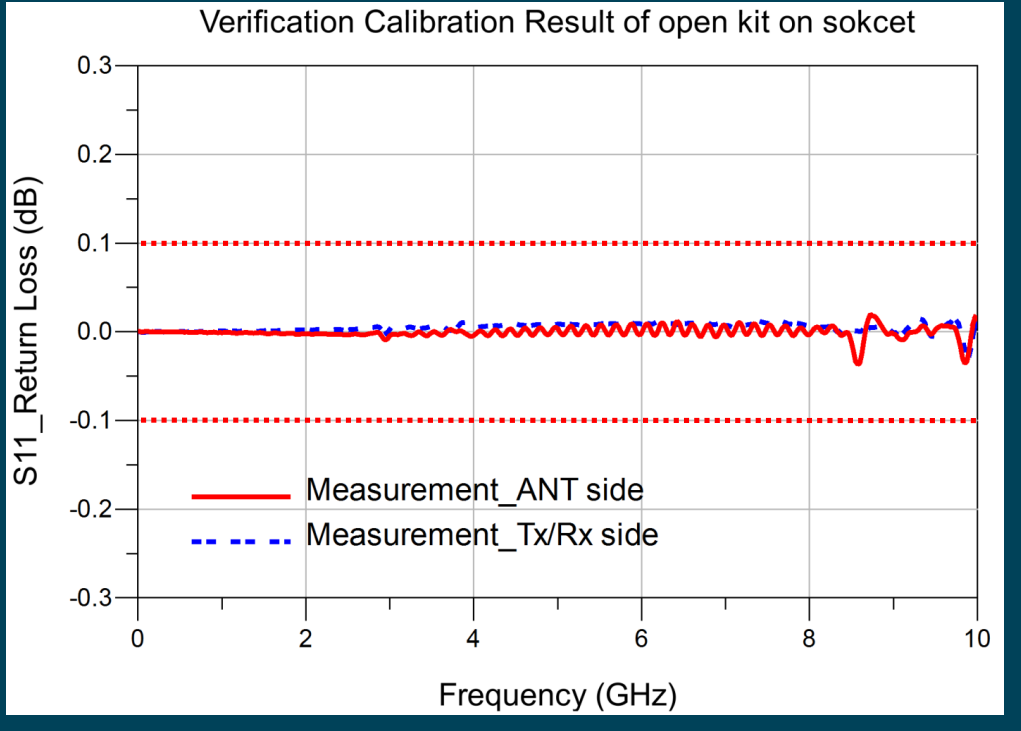


Short



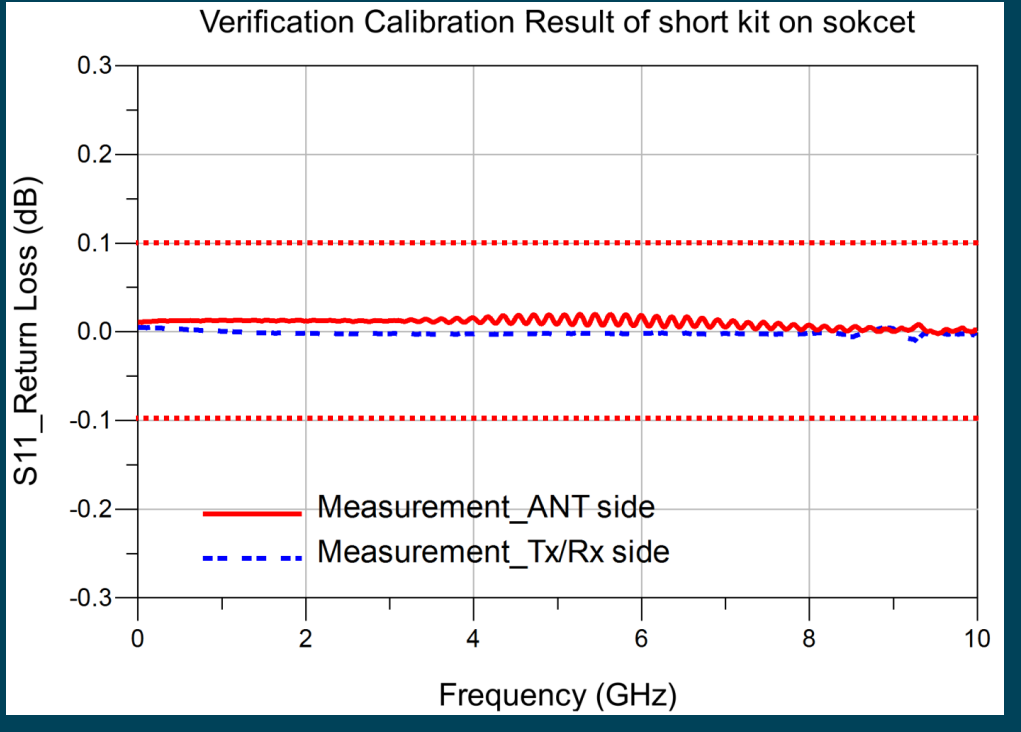
Load

Verify Novel Calibration Kits for Socket Application



- **To verify the calibration result of open kit, the S11 were under 0.1 dB with each side.**

Verify Novel Calibration Kits for Socket Application



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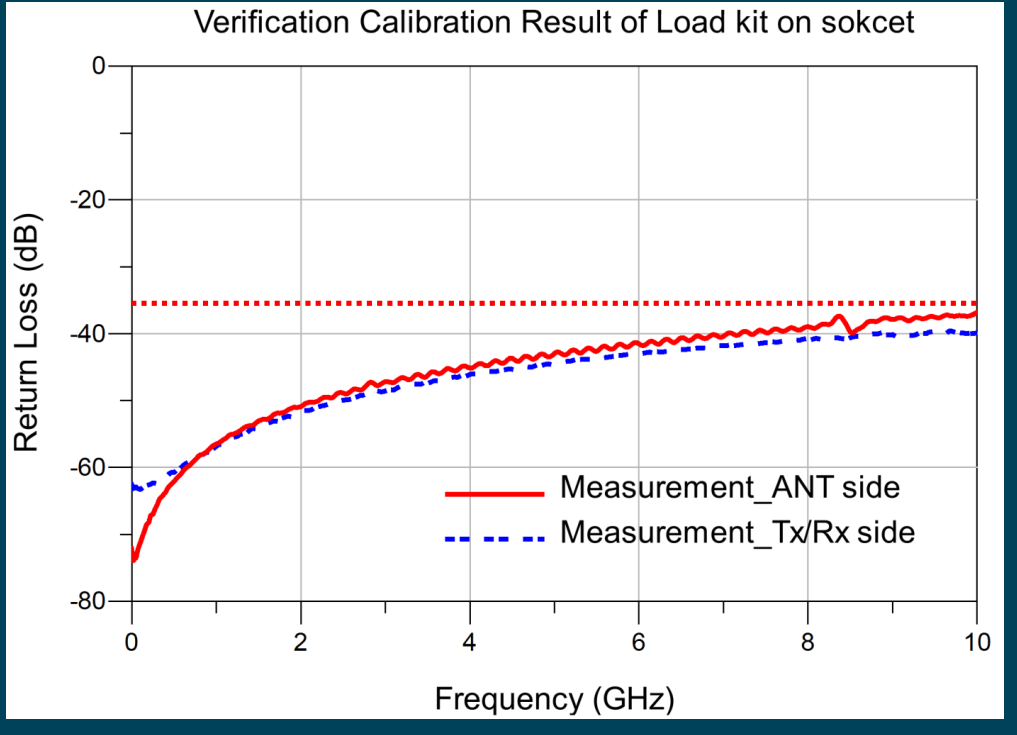
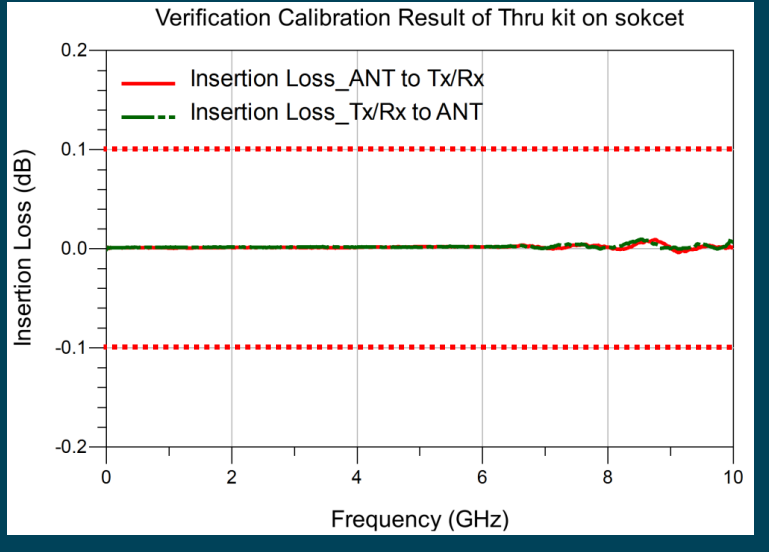
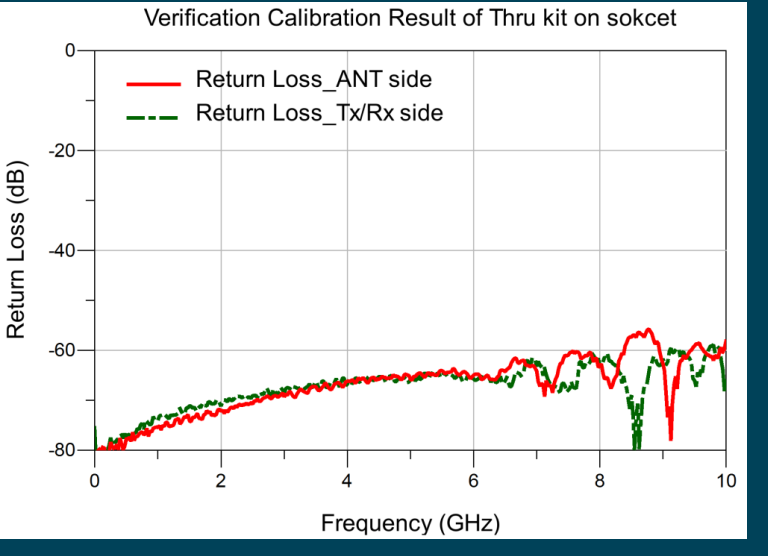
Verify Novel Calibration Kits for Socket Application



- To verify the calibration result of open kit, the S11 were under 35 dB with each side.

Verify Novel Calibration Kits for Socket Application





- **To Verify the calibration result of Thru kit, the S11, S22 were under 40 dB and the S21, S12 of insertion loss were under 0.1 dB.**

Sub-summary

- The standard definition of Novel Calibration Kit for Socket by Jthink as below table:

Standard Definition of Novel Calibration Kit for Socket		
Module	Tx/Rx port	ANT port
Short	$L_0 = 79.3\ pH$	$L_0 = 79.3\ pH$
Open	$C_0 = 93.1\ fF$	$C_0 = 96.5\ fF$
Load	$50\ \Omega$	$50\ \Omega$
Through	$20.833\ ps$	

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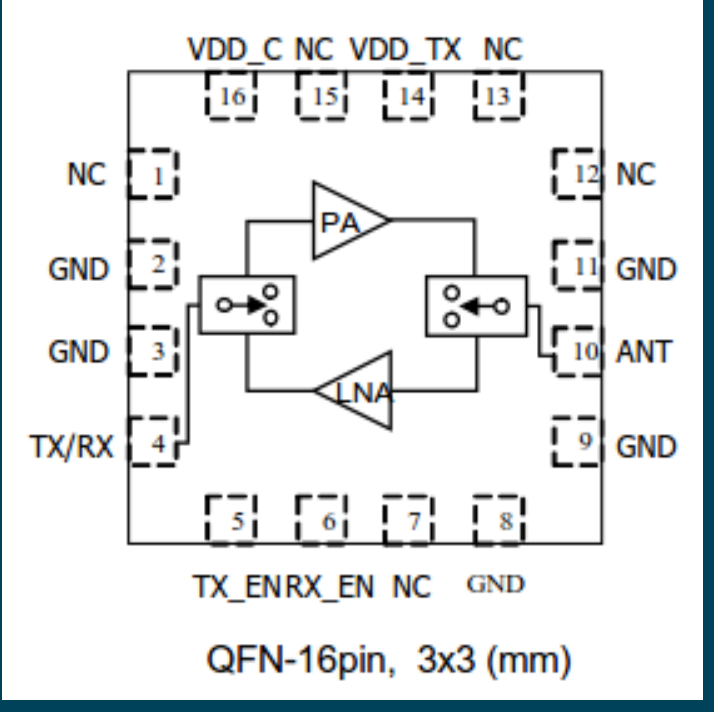
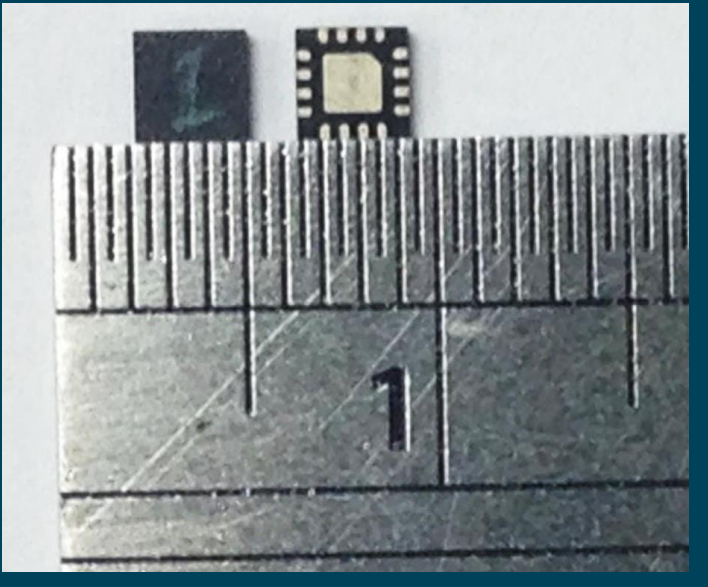
Product - Front-End Module for 2.4 GHz Wireless Band



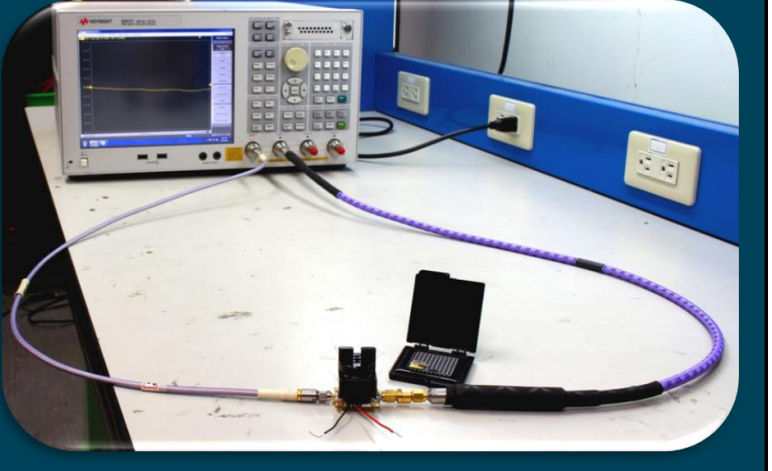


FEM of QFN Package Samples

Measurement Front-End Module for 2.4 GHz Wireless Band

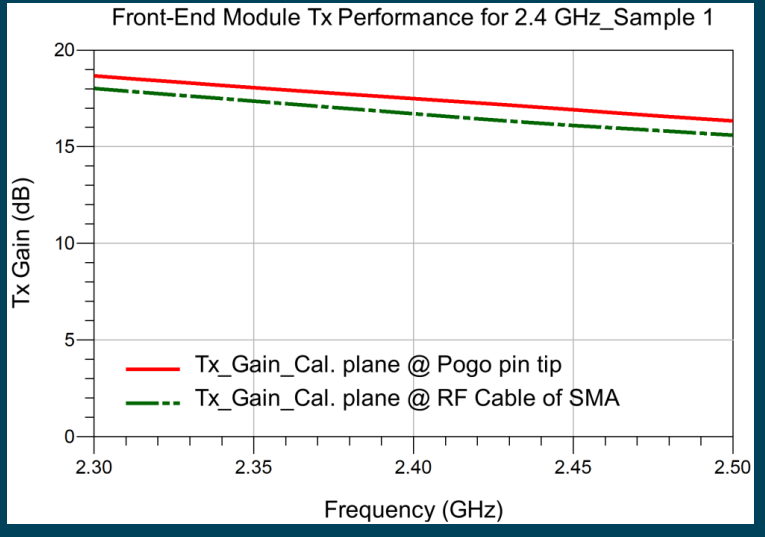
- We used two different calibration kits to verify the FEM performance. One is traditional calibration kit for SMA connector, the other is Jthink solution calibration kit for socket application.

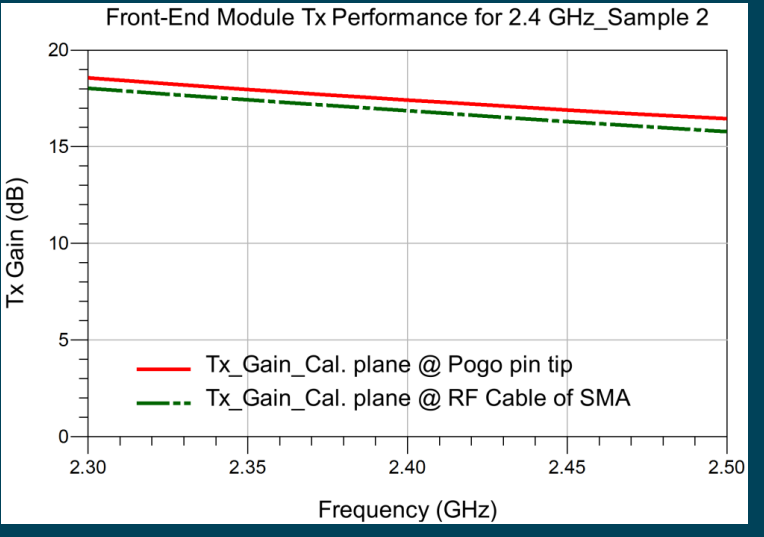
Traditional Cal. Kit
Cal. plane @ RF Cable of SMA



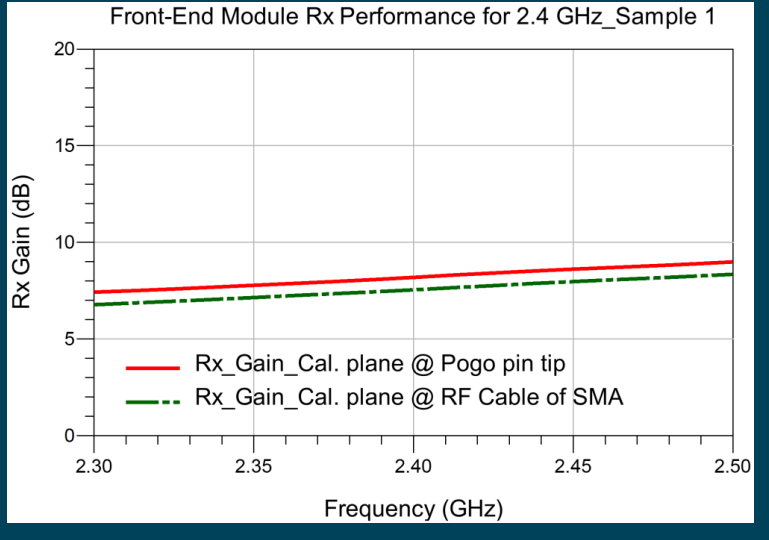
Cal. Kit by Jthink solution
Cal. plane @ Pogo pin tip

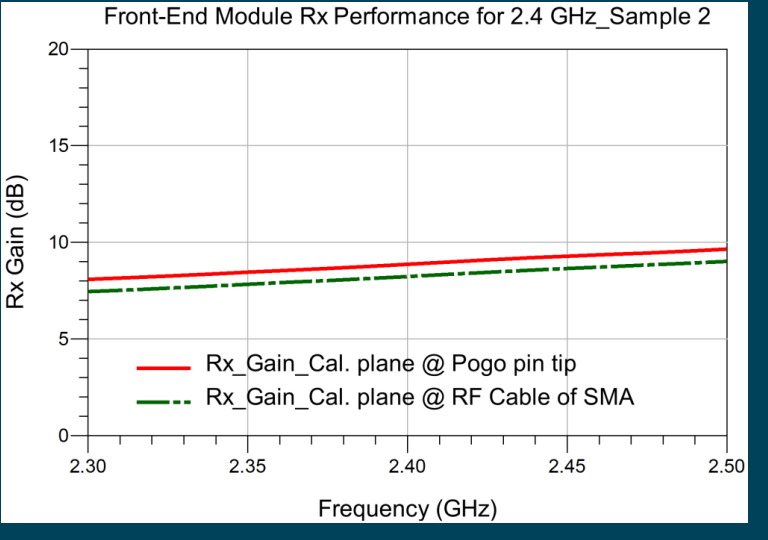
Measurement Front-End Module TX Performance





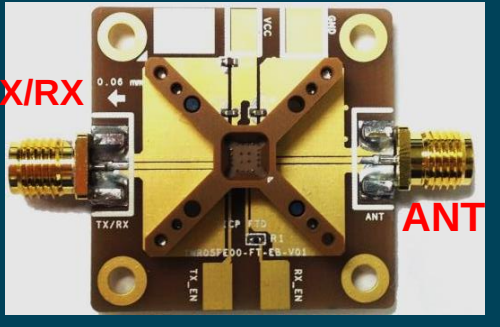
Measurement Front-End Module RX Performance





Summary

Comparison with different calibration kit by VNA calibration			
Test item	DUT	Calibration plan @ RF cable of SMA	Calibration plan @ Pogo pin tip
TX Gain @ 2.4GHz (dB)	Sample 1	16.70	17.49
	Sample 2	16.86	17.41
RX Gain @ 2.4GHz (dB)	Sample 1	7.55	8.19
	Sample 2	8.24	8.87



Difference about 0.7 dB

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Conclusion

- Designed the calibration kit base on SOLT calibration method for socket testing system is available.
- Compared Jthink solution kits with traditional calibration kits, the results were equivalent of Front-End modules performance.
- It's more convenient for On-line calibration and verification in testing line by Jthink socket calibration solution.
- In the future, the advance material will be adopted for high speed and high frequency application.